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Vol.			*Vol.*		
I	3 parts,	1928	VI	2 parts,	1933
II	4 ,,	1929	VII	1 part,	1934
III	3 ,,	1930	VIII,	4 parts,	1935–7
IV,	4 ,,	1931	IX,	4 ,,	1938
V,	2 ,,	1932			

Quarterly publication will be continued in future.

ISSUES OF THE AGRICULTURAL CIRCULAR.

THE following were the numbers and year of issue of the *Circular*:—

Vol. 1, 1920, 12 parts	Vol. 4, 1923, 1 part
,, 2, 1921, 5 parts	,, 5, 1924–5 2 parts
,, 3, 1922, 4 parts	

As Number 4 of Vol. 3 was printed as "Volume 4" and Number 1 of Vol. 4 as "Volume 5" it would appear from an inspection of a complete set that Volume 4 had only a Part 4 and that there were two issues of Volume 5, Part 1.

—EDITOR.

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ERRATTA ET ADDENDUM.

VOL. 9, NO. 4, DECEMBER, 1938.

Page 13, paragraph 3. For " does not so far occur ", read " so far only occurs ".

Page 18, paragraph 3. For " Sow." in last line, read " Serv."

VOL. 9, NO. 3, SEPTEMBER 1938.

Page 32, Value of Cook Islands Citrus Export in 1936 was £28,689, not £25,700.

AGRICULTURAL JOURNAL

ISSUED BY THE

DEPARTMENT OF AGRICULTURE, FIJI.

VOL. 10.] MARCH, 1939. [No. 1.

EDITORIAL.

THIS is the first number of the tenth volume of the *Agricultural Journal* which, in 1928, succeeded the *Agricultural Circular* after its publication ceased in 1925.

An article which is likely to interest many country readers in Taveuni and Vanua Levu is that on the " Local Copra Industry " with its suggestions for ameliorating conditions of the small planter both by growing food crops for household use and by taking up some additional crop of which rubber is especially recommended for the smallholder in the wetter zones.

Another contribution of general interest is that on soil erosion, the importance of which was stressed by Sir Frank Stockdale who emphasised what terracing and strip-cropping can do for soil conservation and the maintenance of fertility. This problem is now receiving the close attention of the Department of Agriculture and it will feature largely in the General Experimental Station at Sigatoka and at Demonstration Farms in the course of the next few years.

During December and January, Fiji just managed to escape being the centre of a hurricane and cotton and bananas suffered very severely from the wind which reached 73 miles per hour on 21st January at Suva.

Bad as the gales were in Fiji, they were even worse in Tonga and Samoa where the Javan parasite of the leaf-miner had shortly before been introduced. Details are not yet available of the mortality sustained by these delicate insects on liberation in their new home but it is to be hoped that enough escaped destruction to ensure subsequent recovery.

The Medical Officer of Health contributes an instructive article on the domestic mosquito and states that, in Suva alone, a little of the elementary control measures practised in other Colonies would halve the numbers of mosquitoes. It would be astounding were it not true that in one of the larger hotels in Suva the staff have not been taught how to hang a mosquito net properly but place it over the bed-frame so that it cannot be tucked in at the head and foot of the mattress. The very perfunctory way that collections of water in and around houses are disposed of is a revelation to anyone coming from other tropical dependencies where such matters have, of necessity, to be treated seriously. The practice of the many suggestions put forward in this useful article should be distinctly beneficial to comfort as well as to health.

Some useful botanical notes are given dealing with one of our common weeds, the sago palm and an edible fungus of common occurrence. The food value of the sago palm in suitable locations is stressed and the edible fungus presents possibilities as a minor industry.

For some years there have been indications of nutritional deficiency in local stock and preliminary suggestions for supplementing the diet should prove of value.

One of the difficulties of growing vegetables in Fiji is that, as elsewhere, there are numerous pests and in this issue means of control of some of the commoner ones are given. The enclosed sheet of formulas differs to a

slight extent in the quantities of ingredients given in the article but either can be followed.

There is also an interesting note on " white ants " in which a method —practised in the West Indies and West Africa—of poisoning whole colonies is described, and is worthy of local trial when an occasion arises.

THE PRESENT POSITION OF THE LOCAL COPRA INDUSTRY.

By
H. W. JACK, M.B.E., D.Sc., B.A.,
Director of Agriculture.

THE years 1936 and 1937 provided satisfactory returns to the copra producers but that period of good prices was insufficiently prolonged to enable estates to recover fully from the financial difficulties consequent upon the slump of 1933–34.

The present depression in the copra industry is causing severe hardship amongst all classes of producers in the Colony and is seriously curtailing general trade, especially in the coconut producing areas.

During the 1933–34 depression a Government Committee was formed to discuss ways and means of assisting the copra industry and of maintaining the production, particularly of estates under European ownership or management.

Every possible avenue of ameliorating the position for the growers was discussed in detail but with the exception of subsidisation of transport and of relief of local taxation, aggregating approximately 10s. per ton of copra, no further practicable scheme could then be devised to relieve the financial tension of the growers.

At that time His Excellency the Governor (Sir M. Fletcher) in Legislative Council Paper No. 3 of 1935 outlined the activities taken in connexion with efforts to assist the copra industry and the steps that had been adopted to provide temporary relief to copra producers. He pointed out that the Fijians were at all times able to procure the necessities of life, even though copra became unsaleable; that individual producers of European and of Native descent, while they had to reduce their standards of living materially, were in little danger of actual want of food and could earn a little money by personally cutting copra. He stated that estate owners, lessees and managers, owing to inability to find money to employ labourers, were suffering acutely and that they had to forego practically everything beyond bare necessities; that most estates were mortgaged but that at that time it was much appreciated that it was not the intention of the local banks to foreclose in spite of the fact that they had been unable to collect any interest for a considerable time.

His Excellency stated that certain copra taxes had been temporarily remitted and that further remission of various dues should be considered sympathetically in necessitous cases. In addition, the inter-island transport of copra was subsidised to a reasonable degree, thus bringing the total amount of relief up to approximately 10s. per ton as already mentioned.

Continuing, His Excellency outlined the main points contained in the despatch from the Secretary of State in regard to the matter in the following paragraphs:—

> " While the principal oil-seeds and nuts were to a large extent interchangeable *inter se* both as sources of oil and as sources of cake and meal, and while the resultant oils were to a large extent interchangeable *inter se* and with palm oil, whale oil, and the animal fats, butter, tallow, and lard (though the actual amount of interchange was less in the case

of oils and fats than in the case of seeds and nuts), the demand for the individual products varied from time to time, chiefly owing to variations in the relative importance of the demand for the cattle cake and meal and for oils and fats, but also owing to other factors. For instance, when prices were low, the tendency was for the demand for butter to increase at the expense of margarine and other substitutes."

"At the present time, owing to efforts which were being made to promote the domestic production of meat, milk, and butter in various countries, there was an increase in the demand for cattle cake and meal which was not accompanied by any marked rise in the demand for vegetable oils and fats, with the result that those products which yielded a high proportion of cake (particularly soya beans which yielded 85 per cent. of cake and 15 per cent. of oil for each ton of raw material, and cotton seed which yielded 82 per cent. and 18 per cent. respectively) had recently increased in demand by a substantial percentage, while there was little recovery in the price of vegetable oils or the seeds and oils which gave a higher yield of oil.

"The only country in the British Empire which imported really substantial quantities of oil seeds, nuts, and vegetable oils was the United Kingdom, but imports into the United Kingdom were much less than the exports from the Colonial Empire and India, which were the only two parts of the Empire substantially interested in the export of these products."

It could, therefore, be appreciated that the vegetable oil export trade of the Colonial Empire could not depend on Empire markets alone and that very large sales must also be made in foreign markets which now bristled with difficulties by reason of the new conditions of tariffs arising out of national desires towards self-sufficiency. Hence the outlook for world markets was profoundly discouraging especially as there was little tendency towards reduction of supplies and that animal fats were gaining more favour at the expense of vegetable oils. In the circumstances, the Secretary of State could foresee no prospect of a sustained recovery in prices of vegetable oils and could not, therefore, approve of any proposal for rendering financial aid to the copra industry, based on any assumption of sustained recovery of demand.

The Secretary of State stressed the need for visualising an entirely new state of affairs in which copra would fluctuate around low levels of prices and that all policy should be shaped accordingly.

The position of copra in the world's markets to-day is much the same as in 1934 except that the competition of other oils has increased to the further disadvantage of copra. The main competitors of coconut oil are produced in standardized qualities and this factor weighs heavily against copra which is very variable in quality and tends to a reduced demand as compared with more standardized products. Hence the need for improvement in quality of the export of this Colony is indicated as one of the means of bettering the local copra situation.

Fortunately for the industry, copra was in strong demand for the years 1936–37, probably owing to the fear of war, so that many estates were enabled to reduce their indebtedness materially and to repair some of the ill effects of depression.

The average local price of copra in 1938 was about £6 2s. 0d. per ton which enabled those estates and small holdings which were managed economically and which were unfettered by mortgages to pay their way but left little margin for reserves or for emergencies.

Estimates of the costs of production of copra locally are very variable according to local conditions and systems of accounts but a fair average price would probably be £4 10s. 0d. per ton (Fiji currency) in Taveuni and Vanua Levu, to which has to be added the cost of handling and transport to the ports of shipment overseas which might be assessed at £1 per ton. This average price, £5 10s. 0d., includes all production costs but excludes reserves for maintenance, cultivation, interest on mortgage, improvements, and other requirements, so that during the year average estates have been enabled at all events to "carry on."

Should the existing period of low prices persist, the position of the majority of European and half-caste producers will certainly become embarrassing and the problem of suggesting ameliorative measures is hedged with difficulties. Nevertheless, there are possibilities to which they can turn, but they should, in the first place, assure themselves and their families of an abundant and continuous supply of the necessary foodstuffs, especially those they can themselves produce on the land, in as wide a variation as may be possible, in order to eliminate cash expenditure under this category as far as may be possible. In this category, starchy foods would naturally play a big part but such foods as fresh meat, fish, poultry, beans, cabbage, tomatoes, lettuce and various fruits should also be included. The small copra-producer, if he wishes, can generally find a fair amount of time in which to give attention to the essential matter of domestic food supply, especially if he is burdened with a large family—as many of them are.

Also, the production of primary food crops is a simple matter provided that reasonable and regular attention is applied to the purpose and that fair average soil conditions are available as they should be in most, if not all, coconut areas.

The existing coconut areas, where they have been moderately well planted so that the palms are tolerably well spaced, may be interplanted with various crops in order to assist in the maintenance of the coconut palms. In this category mention may be made of cocoa, derris, avocado, coffee, vanilla, tobacco, pineapples, dry rice, peanuts, ginger, sisal hemp, tung oil, soya beans, and in dry areas cotton and, possibly, passion fruit and grape fruit for juice extraction. Most of these crops thrive best in light shade, such as would be afforded by well-spaced coconut palms, and in a well-distributed rainfall. Moreover, wherever fair drainage is assured they would all thrive under the average soil conditions existing in the coastal coconut lands.

Provided that moderate attention is given to the preparation, curing, grading, &c., of the commodities mentioned and provided that they are produced in fair quantity and that reasonable prices are expected, markets could be found for them all either locally or overseas. A few of them, such as vanilla, tung oil, soya beans, would be of an experimental nature in the first instance, while cotton might prove precarious owing to rather inclement conditions at times. Rice might also suffer a good deal from pests when grown amongst coconuts in small areas and from pigs, unless some protective measures can be taken against them, but the practice is common and successful in parts of the East where the small settlers are industrious.

Another crop worthy of consideration in the wetter areas is rubber, but this should not be planted amongst the coconuts, except in poor and uneconomic producing areas, as rubber will eventually choke the coconuts.

Planted in small blocks, under semi-forest conditions, rubber holds moderate prospects for the smallholder or small copra producer who is prepared to give the young growing trees fair attention and when mature to tap them regularly, systematically and with moderate care. The other crops, already

mentioned, can readily be grown for several years as catch crops for the rubber, just as pines, tapioca, maize, pepper, &c., are grown in Malaya.

None of the crops mentioned are of particular difficulty in preparation for market but they all demand moderate anv continuous care and co-operative marketing would be distinctly advantageous especially in regard to the ever present problem of transport, both local and overseas.

Seeds of many of the plants mentioned are locally available and limited supplies are available through the Department of Agriculture or can be ordered as required and the Department will gladly render all possible advice and reasonable assistance on request, to interested applicants.

While these practical possibilities are mentioned, it must be borne in mind that there is no " royal road " to agriculture—it cannot be unduly hastened, it is subject to the elements of nature and to many other aggravating factors and its success demands and must have continuity of moderate effort on the part of the producers, otherwise there is little chance of achieving worthwhile results.

In the 1934 depression the coconut planters made a valiant stand against adverse conditions and it is obvious that they are again doing so and that they will continue to work hopefully in the future, should depression of the price of copra continue or increase, though it is sincerely to be hoped that improvement will materialise in this respect.

It is also hoped that these brief notes may prove helpful, especially to the small individual European planter and to producers of mixed European and Native descent to whom it is particularly directed.

SOIL EROSION.

Compiled by
D. A. DONALD, H.D.A., Agricultural Officer, West.
and
SILAS RAM JAN, Indian Field Assistant.

Soil erosion is the destructive, crumbling and pulverising action of natural forces, such as wind and rain, on the surface of the earth. It is a process which goes on in all places and at all times, varying with local conditions. The major cause of soil erosion in Fiji is water.

The residence of land surface to erosion varies from place to place. It depends mainly on:—

1. the slope of the land;
2. the type of the soil;
3. the condition and amount of surface-cover.

An absorptive soil will have a much greater resistance to erosion than an impermeable soil.

EFFECTS OF SOIL EROSION.

The surface soil, which contains the greater part of the nutrient matter and the whole of the organic food of the plants, is removed by soil erosion, The lost fertility of the soil cannot be restored merely by application of manures. The once fertile slopes not only lose all their fertility but the land is left in such a wasted condition that it is beyond reclamation and in this way permanent agricultural land is destroyed. Agricultural areas below the eroded land, such as paddi fields, may be ruined by the deposition of large quantities of sand and silt.

In America the soil erosion conservation service showed that the area of formerly cultivated land which has been destroyed for further ploughing amounts to 109 million acres. It was estimated that over three-fourths of the top soil and some sub-soil have been lost from a further 192 million

acres. For many years before the exact extent of the damage was known the American people were experiencing the results of soil erosion in dust-storms which caused tremendous damage and destroyed the livelihood of tens of thousand of farmers.

Great interest and concern is now evinced in other countries such as Australia, Africa and Japan in the question of soil erosion, and although erosion in Fiji has not attained serious proportions it is high time that erosion control methods were understood and practised.

CONTROL OF SOIL EROSION.

As soil erosion is caused originally by the free movement of water on the surface of the earth, it is first necessary to control the movement of any surface water by reducing to a minimum the speed of the water.

To reduce soil erosion to a minimum it is necessary to:—

1. Protect the soil from the direct erosive action of rain water falling on it.
2. Obtain the maximum absorption of the rain water where it falls.
3. Control the removal of surplus rain water.
4. Arrange for the collection and replacement of any eroded soil.

The primary aim in controlling erosion is to reduce the force with which the rain falls upon the surface. To effect this it is necessary to cover and protect the soil from the direct beating action. The less height from which the rain water falls the less its erosive action will be. Therefore it is essential to have some suitable low-growing cover crop which will also increase absorption by the soil and reduce the rate of flow of the run-off. Cover crops may be sown for the purpose or, in the case of perennial main crops, natural growth may be utilized. A low-growing cover crop effect three of the four measures mentioned above, therefore all farmers should thus conserve the soil and realize the necessity of ground cover-cropping.

TERRACING AND CONTOUR STRIP CULTIVATION.

Where sloping land is to be cultivated, the cultivator should practice terracing, contour planting or strip cultivation.

Terracing.—A method which can be adopted to reduce soil erosion on hillsides is to cut terraces* resembling large steps along the face of the slope. The edge of each step must be firmly held by a grass bank so that rain water will not corrode the edge. Thus the whole surface resembles a large platform and planting is carried out on the flat in the usual way. The general system of contour ploughing can be utilized to make terraces by repeatedly throwing the furrow away from the hill and levelling it. Terraces are made around the hillside, which also act as drains for the removal of the run-off water. These should be designed in such a way as to reduce the velocity of the flow of the run-off. Terraces conserve both water and soil.

Contour strip cultivation.—The contours can be made by ploughing about $\frac{1}{4}$-chain wide and then leaving the same width of virgin land and so on around the hill. Contour strip cultivation prevents the water running directly downhill and enables the eroded soil to collect on the virgin land.

The most obvious method of achieving contour farming is to carry out all ploughing, cultivating and sowing along level lines, that is, crosswise to the main slope rather than up and down the slope. On land which is "countour-farmed" every furrow and row of the crops will lie along lines which curve around in order to fit with the slope of the land surface. Every

* For the correct distances apart of these terraces see "Conservation of Soil by Terracing" which follows this article—EDITOR, A.J.

furrow acts as a small dam to check water flowing directly downhill. Many farmers who have adopted this practice find it worth while, as it is easier on draught animals and agricultural implements.

Bank and ridges —Another most effective and practical method of checking erosion on sloping agricultural land is to construct banks or ridges across the slope in order to prevent the water directly running downhill. If these were made horizontal, water would be dammed up behind them and under most conditions they would have to be unreasonably high if they were to hold back a heavy fall of rain. Therefore it is usual to give such banks a small slope in one direction. By giving a gentle slope the water flows much more slowly and has a little erosive power.

A very effective measure for the purpose of controlling downward movement of soil on slopes is to plant a continuous (single row) grass border along the edge of the upper side of the contour drain. This can be established at a very small cost and in time grows higher and forms a small bund or terrace as soil collects. Several types of upright growing grass are suitable for this purpose, but in all cases they require to be closely planted. Vetiver, Gerara and Guinea grass are very suitable for this purpose in Fiji. Whatever type is used the grass will always require to be controlled and kept within bounds. The grass cuttings can be used as a surface mulch, fed to stock or reserved for thatching purposes.

Many farmers have proved that the control of erosion is a fairly simple matter if broad base contour banks are used. Contour banks have proved so valuable in America that six million acres of agricultural land in Texas alone have been treated in this way. This is equal to 1½ times the total area of land in the 250 islands comprising the Colony of Fiji.

In addition it is frequently found, especially in dry areas, that crop yields are increased because more rain soaks into the soil than when it runs off without interruption.

The loss of the most valuable part of the soil by erosion is a waste of agricultural land. Economic production depends upon the maintenance of the soil, therefore it is then essentially the duty of all farmers to conserve their soil by protecting it from erosion and to realize the necessity of ground cover-crops, contour planting, terracing and strip cultivation which assist and reduce to a minimum the erosion of the soil.

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CONSERVATION OF SOIL BY TERRACING.

Inquiries have been received as to the distance apart that terraces should be placed on different degrees of slope and the following figures will serve as a general guide in this respect.

For a drop of	1 foot	in	100 feet	make terraces	200 feet apart.
,,	2 feet	,,	,,	125	,,
,,	3	,,	,,	100	,,
,,	4	,,	,,	90	,,
,,	5	,,	,,	80	,,
,,	6	,,	,,	70	,,
,,	8	,,	,,	60	,,
,,	10	,,	,,	50	,,
,,	12	,,	,,	40	,,

Terracing is undoubtedly one of the most efficient methods of conserving cultivated soils on sloping lands and the best type of terraces are those known as broad base terraces which can, in many cases, be constructed entirely by the plough. They should, of course, always follow the contour of the slopes. —H.W.J.

WHAT YOU SHOULD KNOW ABOUT MOSQUITOES.

By
S. R. BAXTER, M.D., D.P.H.,
Medical Officer of Health.

Fiji is indeed lucky—or perhaps unfortunate in some respects—in that the local pests do not result in fatal and weakening diseases such as the dreaded yellow jack or yellow fever of West Africa or malaria which is the curse of most tropical regions of the world.

Had such diseases been present in Fiji, there is no doubt that public interest would have demanded most stringent anti-mosquito measures. To a newcomer from an area where a wholesome respect for the disease-carrying mosquito is ingrained, the almost complete apathy in Fiji to these pests is unbelievable.

Let us not forget, however, that there are districts in the Fiji Group where elephantiasis with enormously swollen limbs, &c., is common and this dread condition, which is known also as filariasis, is mosquito-borne.

Let us not forget that periodic epidemics of dengue fever (break-back fever) also occur in Suva itself, and that this is also due to these irritating pests.

Let us not forget that newcomers demonstrate violent reactions to the poison of mosquito bites, whilst old inhabitants, with complete immunity regard mosquitoes as inevitable and quite unavoidable.

Let us not forget, and let us be thankful for the fact, that, because of its geographical position, and stringent quarantine measures, the malaria mosquitoes (Anopheline mosquitoes) do not exist in these islands. Should they ever be introduced, I shudder as to the consequences.

Let us not forget that modern methods of transport, especially air transport, threaten this isolation, and bring nearer the possibility of malaria and other mosquito-borne diseases, especially yellow fever. This is no silly dream but a very real and true statement of facts.

Let us review the facts, and see what can be done. The following statements are true, although they may seem incredible to the people of Fiji who have always enjoyed so great a relative freedom from the diseases which afflict other tropical countries.

1. There is no need for over 50 per cent. of the mosquitoes in Suva.

2. The mosquitoes prevalent in Suva are " domestic breeders "; that is, they breed for the most part in and about your own houses. For all practical purposes there are two kinds—the black and white or tiger mosquito (*Stegomyia*) which bites and is prevalent in the day time, which does not " ping " as it passes your ear. There is also the larger greyish-brown one, which is more active at night time and which makes a distinct " ping " in your ear as it flies about. This is the *Culex* mosquito—which because of its irritating ways is known as *Culex fatigans*—the tiring or annoying mosquito.

3. Many people who have lived in Suva for many years do not know what a mosquito larva looks like, and do not believe these wrigglers, as they are called, develop into mosquitoes.

4. Many people who have lived in Suva for many years are unknowingly breeding mosquitoes in their own kitchens, in their own rooms, and in their own grounds. It is an undoubted fact that if your own house is pestered with mosquitoes, you can always find a breeding place for them if you look for it, certainly within 100 yards. I cannot stress this fact too strongly.

5. Mosquitoes breed in water—even the smallest collection of water will suffice. They have their likes and dislikes, like flowers have for particular soils. The *Culex* mosquito always selects foul and dirty water, septic tanks, dirty drains, &c. The *Stegomyia* breeds in fairly clean water in tins, bottles, tanks, gutters, old motor tyres, flower vases, fern houses, and in receptacles containing water under the legs of food safes, &c. An old tin concealed in grass near your house will suffice to infest your rooms with mosquitoes.

6. It takes about a fortnight for a mosquito to develop from the egg into the larva, and then from a pupa into an adult mosquito. Mosquitoes do not like running water, and that is why you find larvæ after a fairly long dry spell, when they develop in pools left in soapstone drains, &c. They are washed away in heavy rain.

To demonstrate how common mosquito-breeding conditions are in Suva, perhaps I can enumerate places where I personally have found them, without extra effort on my part. Most of these sites were available simply through lack of knowledge in the householder of likely breeding places. An officer trained for anti-mosquito work has an uncanny eye for (to him) most obvious breeding places— quite unsuspected by the ordinary householder. I should also mention that the presence of mosquito larvæ is a serious offence in places where mosquitoes are a menace to health, and is followed by a fine under public health legislation. Persons who tolerate mosquitoes breeding in their compounds are as much to blame as people who allow accumulations of rubbish to breed flies and to encourage rats, &c., and they should not be allowed to bring ill-health and disease to their neighbours, to say nothing of the annoyance caused to occupants of adjacent compounds by these insect pests.

The following are places in which I have found mosquitoes breeding in Suva:—

1. Water in receptacles under legs of meat safes—usually in kitchens. The mosquito is no respecter of persons, and I have found them in kitchens of all classes of people, from the highest to the lowest, in hotels, boarding-houses, restaurants and private houses.

2. In drums, tins, coconut shells and old motor tyres in private grounds and open spaces—especially if overgrown with weeds. Favourite spots are around the cook-house and just outside the garden fence. Again no class of the community is exempt and—dare I say it—even doctors are offenders sometimes, unknowingly.

3. In water tanks, in institutions such as schools and even hospitals, in dairies in rural districts, and even in drinking water served on the table in a first class hotel under European supervision.

4. In drums, drain pipes, old machinery and lorry parts stored by contractors, private and otherwise. Old cement drums, and paint tins, &c., are usually disposed of in the nearest "bush" where they cannot be seen.

5. The most prolific source I found in Suva was in the old town septic tanks near the new Government Buildings. I am not exaggerating when I say these contained millions of mosquito larvæ, quite open to the air, and many hundreds of *Culex* mosquitoes emerged every night.

6. In a pit under a stone-crusher on the foreshore.

7. In a punt on a slipway of a private contractor. Any vessel left open to the rain is likely to breed mosquitoes after a week or so. The punt I saw was practically solid with mosquito larvæ. I also found larvæ in sugar punts from Nausori.

8. In ponds in private grounds. In plates under ferns on the verandah of a prominent hotel. In flower-bowls in private houses. In obstructed drains in private grounds.

9. In water receptacles embedded in the soil in derelict fowl pens. In a child's pram left out in the rain.

10. In flower cases and open graves at the cemetery.

11. In holes in trees. The main offenders in Suva are "ivi" trees, (*Inocarpus*), old flamboyante trees, bamboo clusters, pawpaw trees (bamboos and cut pawpaw trees are specially bad), in cut banana stumps and in banana leaves left on the ground.

12. In holes left after telegraph poles and fencing posts had been removed.

13. In pools left in soapstone drains, in dry weather (if we ever have any). In culverts under roads, &c., holding water long after the rains.

14. In holes in swampy ground left by cattle trampling about.

15. In collections of water under grass in Albert Park and the Botanical Gardens.

16. In obstructed and sagging roof gutters in private houses, and in one case outside a public restaurant.

17. In newly-constructed pit latrines, and pit latrines in which the water-level rises during heavy rain. Clouds of *Culex* mosquitoes often emerge from these. In unfinished and completed septic tank installations for private houses or institutions.

This should suffice—I could go on indefinitely. If I could impress upon the people of Suva the dangers of tins and bottles, and the fact that mosquitoes in Suva are largely the result of neglect, I should have done a great deal of good. I should like to stress the fact that all control of insect pests, and this applies to flies, cockroaches, bugs, beetles, sandflies, &c., depends on destroying their breeding places and not on destroying individual insects. Don't blame rice fields, trees, drains, &c., when you may be breeding mosquitoes in your own homes, under your bedroom windows.

Suva does not need a "mosquito week," it needs continued and constant vigilance on the part of the public if it desires to be mosquito-free. I am sure it will be worth while but it is for the public to decide.

Schools should see that their teachers and pupils are mosquito-conscious and understand practical methods of prevention.

Specimens of mosquito eggs (egg-rafts of *Culex* mosquitoes) and of different kinds of mosquito larvæ and mosquito pupa can be seen at the Health Office. There is no mystery about them—they can be found and seen by anyone.

If everyone helped, I am quite sure that more than half the mosquitoes in Suva would vanish. The authorities are aware of their responsibilities, and are doing what they can, as funds permit, to improve drainage conditions &c., but the public must co-operate in getting rid of quite unnecessary domestic breeding-places.

(As further proof of the present state of local knowledge of mosquitoes it is worthy of remark that the *Pacific Islands Monthly* for February 15th, 1939, has a contribution from a Fiji resident who states that the malarial mosquito is present in Fiji although it is well known not to occur east of the New Hebrides. He further remarks that "it is reported on good authority that mosquitoes have got as far north as Great Britain"; actually, 29 species are present there, some having been described 150 years ago.—EDITOR, A.J.)

VEGETABLE GARDEN PESTS AND THEIR CONTROL.

By
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Entomologist.

MANY people keen on gardening, and also those who grow vegetables and salad plants simply for the table, often find their crops attacked by various insects. In this article an attempt has been made to give some hints on control for the more common of such pests which have either been seen by or reported to the writer during the last eighteen months or so.

For easy reference the pests are grouped according to their type or kind, briefly described with their favourite host-plant and general control measures then given for each division. The size of the pest is given in millimetres, of which 25 equal approximately one inch.

"CUTWORM" CATERPILLARS.

Prodenia litura F., *Phytometra chalcytes* Eipe and *Heliothis obsoleta* F.—These are usually olive-green to brown caterpillar pests of cabbage and tomato, generally found feeding by night about ground-level. As detailed measures for their control are given in the *Journal* for September, 1938, (page 22), it will not be necessary to repeat the proportions of the ingredients for the poison bran bait.

OTHER CATERPILLARS.

As it is virtually impossible for anyone but a specialist writing for specialists to give descriptions which would serve to identify the various caterpillars, it is desirable instead to list briefly the adult moths into which they develop. A certain sameness is inevitable but this method seems best for reference and completeness.

Plutella maculipennis (Curt.), a dark-brown and yellow moth, wing span of 16 mm. Leaves of cabbage are eaten by the green caterpillars which may attack the heart and completely spoil the plant for human consumption.

Crocidolomia binotalis Zell., a cream-coloured moth with brown markings, measuring 23 to 25 mm. across the forewings. Cabbage leaves.

Hellula undalis F.—This moth is only 15 mm. across with brown marblings on a tawny background. So far apparently recorded locally only from Vanua Levu and also on cabbages.

Margaronia indica Saund.—This distinctively-marked moth has a central white area on the wings with a wide border of dark brown. Its span is 27 mm. and its usual food-plants as a caterpillar are cucumber and pumpkins.

Dræcenura pelochra Meyr.—A cream-coloured moth with two brown undulating lines and spots: it measures 22 mm. across the wings and is common on Taveuni on beans whose young shoots it severely damages.

Maruca testulalis Hbst.—Like the preceding, this a nocturnal moth flying around growing bean plants. The forewings are brown with a white or silver key-hole mark, while the hind wings are white with a brown outer margin. It measures the same as *Dræcenura*, say seven-eighths of an inch.

Argyroploce (*Cryptophlebia*) *illepida* Butl., was the subject of an article in the issue for March, 1938, p. 22, where it was described as an ivi (*Inocarpus*) pest, but it also occurs on Mauritius beans.

Zizera labradus Godt. *mangœnsis* Butl. is a small blue butterfly measuring 25 mm. with a squat and slug-like caterpillar. Another bean pest, but on the flowers, not the leaves.

Hymenia fascialis Cram.—The caterpillar of this moth is known only too well to beet growers though *Amaranthus* is also attacked. The adult is

brown with two large white areas on the forewing and one on the hind: its span is 20 mm.

Doleschallia bisaltide Cram.: a hairy black caterpillar which may defoliate *Eranthemum* and develops into a large (70 mm.) brownish-yellow butterfly with black wing tips: the lower surface mimics a dry leaf—a good example of camouflage from its bird enemies.

Sylepta derogata F.—The predominant colours of this moth are pale orange with a brown network. It has a wing span up to 30 mm. and its green larva eats *Hibiscus* leaves.

Control.—For all the above caterpillars where only a few plants are attacked and the area is small it is usually possible to have labourers' mosquito netting run over a light framework of sticks. In cases where this is not possible the best treatment is dusting with pyrethrum powder mixed with three or four times its volume of wood ashes or flour. This insecticide is made from the dried flowers of chrysanthemums and rapidly loses its efficacy if not kept well stoppered and dry. Particular attention should be devoted to this point especially in the dry season with its higher humidity (over 80 per cent.): it will be found a worth-while practice to keep the bottle or tin, when not in use, in the kitchen or copra drier.

If a stronger and more poisonous insecticide is required, the following sprays are recommended but should not be used for edible leaves less than ten to fourteen days before gathering them:—

2 oz. of lead arsenate powder *or* 4 oz. of lead arsenate paste dissolved in six gallons of water. Stir well before and during application so as to avoid the application of too much solid matter over a small area of leaf surface. Calcium arsenate powder is cheaper but is more poisonous: alternatively, use only 1½ oz. mixed with ¼ lb of slaked lime in 6 gallons.

BEETLES.

Cucumber and pumpkin leaves are usually damaged by a larger (8 mm.) beetle, orange above and black below and a smaller one (5 mm.), yellow with four square black spots. These insects are respectively *Aulacophora coffeæ* Horn. and *A. quadrimaculata* F. and are popularly but erroneously called lady-birds which are always nearly circular in outline with a retracted head. Pyrethrum, one part to 3 or 4 of flour or wood ashes is good.

With cucumber, tomato, egg-plant and Cape Gooseberry (*Physalis peruviana* L.) one oftens finds the leaves reduced to a skeleton. The damage is done by a yellow ladybird with many black spots, measuring 6 mm. in length and known as *Epilachna* 28-*punctata* F.—apparently our only harmful ladybird.

Control.—All these beetles can be combated with fortnightly lead or calcium arsenate sprays as explained above for caterpillars. Various other ladybirds are likely to be present in gardens but they are beneficial as their grubs eat scale insects, mealy bugs and aphis. Bordeaux mixture, as detailed under slugs, can also be used. Lime and tobacco dust in equal parts is a good protective powder.

The so-called Japanese rose-beetle, *Adoretus versutus* Har., is too well-known to need description as its damage to rose leaves is only too common throughout Fiji, which it reached about the beginning of the century. Specimens of this brown beetle were sent in 1937 to the writer from Ra Province, where it was said to be damaging bean leaves—a new record, if substantiated.

The erection of a bamboo fence and a cheesecloth net were recommended by Jepson in 1911 and these methods with hand collection at night are still

in vogue. A hurricane lamp suspended by its handle over a large zinc bath tub of water with a film of kerosene attracts many, but care must be taken when lighting and removing the lamp. Light forking of the soil to kill the subterranean grubs and pupæ could be carried out: the ground-ant *Pheidole* then attacks these stages.

SUCKING BUGS.

The insects described so far have all had one thing in common, viz., that the damage done was a bite by jaws, with the removal of solid plant material. True bugs, however, have a sucking proboscis and are sap-drainers: usually they are chemically controlled, not by stomach poisons, but by some fluid directed onto their exterior—what is known as a contact insecticide.

The chief pests are the snow-white mealy bugs, the disc-like scales and the aphids or "green-flies." Fortunately they are preyed upon both by larval ladybirds and the so-called hover flies which are banded somewhat like a wasp and have a metallic sheen. Aphids (*Aphis maidis* Fitch.), are very common on the male (terminal) flowers of maize.

Pumpkins are often damaged by a large black bug with a red band on its thorax, having a length of 17 to 20 mm.: this evil-smelling insect is *Leptoglossus australis* F. Somewhat larger and stouter and marked with a buff saltire is the crusader bug *Mictis profana* F. which sucks sap from young shoots of roses, Cassia and citrus. The black and yellow wingless nymph may often be seen feeding on the terminal shoot of all these plants whose buds consequently fail to develop.

Control.—For all of these insects the following standard spray should meet the occasion:—

> Dissolve two ounces of shredded soft soap in 1 quart of boiling water. Remove from fire and add two quarts of kerosene. Churn with a pump into a creamy solution till there is no free oil left.

This mixture is the stock solution which just prior to spraying should be diluted with 9 times its volume of water. If any free oil appears, more soap must be added till it disappears after further churning.

FLIES.

The only flies which are true pests on garden plants are the fruit-flies whose control by means of a sodium silicofluoride bait spray is described on page 20 of the *Journal* for September, 1938. In most gardens, bagging with cheap calico is economical for grenadillas, while the Queensland lure (one tablespoonful of ammonia, one teaspoonful of vanilla essence dissolved in three breakfast cups of water) in conjunction with glass traps forms an additional line of defence. The solution should be renewed once a week and the dead flies removed.

In rotten fruit one finds the "ripe rot flies" (*Drosophila* spp.) but these, with other flies found in decaying vegetation, are secondary pests attracted to plant matter after decay has already begun.

ANTS.

Ants may be a pest by attacking very young seedlings, nesting in plants or by protecting and encouraging aphids and mealy bugs. A kerosene emulsion spray is effective usually for those on plants, while carbon disulphide should be poured into the burrows.

Lands Department, Suva.


180°
179°
178°
Undu Pt.
Lighthouse
Ndrua
VISONGO
Nggelelevu
Nukumbasanga
TO VANCOUVER VIA HONOLULU
TO SAN FRANCISCO VIA SAMOA AND HONOLULU
Kumbulau Pt.
Rambi
Thombia
Yanutha
KIOA
Yanutha B.
LAUTHALA
NGAMEA
TAVEUNI
WAIYEVO
(Radio)
Wailangilala
Lighthouse
Vuna Pt.
SALIALEVU
NAITAMBA
Bay of Islands
Avea
Vanuambalavu
Thikombiailau
YATHATA
Kaimbu
KANATHEA
LOMALOMA
Susui
MUNIA
Vatuvara
Mango
L A U
Katafanga
JUVUTHA
Yaroua
Thithia
NAYAU
Bacon Id
Vanuamasi
Lakemba
Aiwa
VANUAVATU
G R O U P
ONEATA
Olorua
Komo
MOTHE
Karoni
Moala
WANGAVA
NAMUKAILAU
Navutuira
Totoya
Kambara
Yangasalevu
Navutuiloma
Marambo
Fulanga
ONGEALEVU
Ongeandriki
Matuku
180°
179°
178°

A useful but poisonous solution consisting of the following two separate solutions is a good slow poison which is taken back to the nest by the workers and fed to the community which thereby perishes:—

Granulated sugar	1 lb	Bring to the boil in a pint of water.
Tartaric Acid	1 gramme	
Honey	2 oz.	

Dissolve $\frac{1}{8}$ oz. ($3\frac{1}{2}$ grams) of sodium arsenite in an ounce (2 tablespoonfuls) of boiling water. When cool, add the second solution to the first one and stir well. Soak fragments of a sponge in it and place away from pets, poultry and children. As this requires accurate weighing it is best made up by a pharmacist.

This concludes the account of the more usual harmful insects found in gardens but for the sake of completeness some non-insect pests are mentioned with their control measures.

MITES OR "RED SPIDERS."

Only one mite is common in gardens and this is *Eriophyes hibisci* Nal., found chiefly on Hibiscus leaves which are yellowed and puckered. Finely-powdered ground sulphur is better than flowers of sulphur as a dust and should be shaken from an old pepper pot or otherwise evenly dusted on the leaves when wet with morning dew. Severe attacks need a spray of an ounce of flowers of sulphur and 2 oz. of soft soap dissolved in a gallon of water.

LAND CRABS.

The land crab or "lairo" does much injury to plants by night. The simplest method is to pour a dessertspoonful of carbon bi- (or di-) sulphide into each main burrow and plug with mud.

Another poison can be made by three-parts filling a four-gallon kerosene tin with water and adding enough corn meal to permit of stirring the mixture easily. Boil and stir till quite dissolved, one three-inch stick of phosphorus: place in the crab-holes away from poultry. This method was used with some success on Ovalau in 1938.

SLUGS.

The old-fashioned way of dusting with fresh air-slaked lime is being replaced by the use of the solid "Meta" fuel used for spirit lamps. Unfortunately, this substance does not appear to be stocked in Suva but glowing tributes to its efficacy are being made in many current journals all over the world. Sacks, boards, bricks, flowerpots, &c., all harbour slugs and so should be moved periodically and the slugs collected.

Heavy applications can also be made on alternate evenings of calcium chloride (chloride of lime) and one part of salt to ten parts of lime. A good repellant is Bordeaux mixture which should be made in two separate solutions as follows:—

Dissolve $\frac{1}{2}$ lb of copper sulphate ("bluestone") in $2\frac{1}{2}$ gallons of water in an earthenware, wooden, glass or copper vessel.

In another vessel of any kind dissolve $\frac{1}{2}$ lb of quick lime, also in $2\frac{1}{2}$ gallons of water.

Just prior to use, pour the two solutions simultaneously in a joint stream through a copra sack or through wire gauze into a tank.

MILLIPEDES.

These creatures have two pairs of appendages per segment and may be controlled by sprinkling on the soil either 9 parts of sugar to 1 part of dry

Paris green or one 2-grain tablet of mercuric chloride dissolved in a pint of water. The poison bran bait for cut-worms will also do.

WORMS

Earthworms were reported from Vanua Levu in 1938 to be damaging the greens of the golf links. Here, as on garden lawns, the idea is to bring them to the surface and collect them; this is accomplished by dissolving 1 lb of corrosive sublimate (mercuric bichloride) in one gallon of boiling water, and adding four more gallons of cold water when cool. Two and a half pints of this solution in 50 gallons of water are to be applied to the turf through a sprinkler. Another way is to scatter 1 lb of lead arsenate to every 100 square feet and water the grass. These amounts are only for large areas such as links.

In the garden, worms aerate the soil but if too numerous in flower-beds, they can be controlled with ½ oz. of corrosive sublimate dissolved in 4 gallons of water. For arsenical poisons it will probably be necessary to sign the Poisons' Book when buying from the local chemist.

This article does not claim to be an exhaustive account of all the pests to be found in gardens throughout the islands of the Colony but it is hoped that it does give the most usual and injurious ones and shows the lines on which they should be tackled. Where insects are sent in for a report it is hoped that attention will be paid to the hints given in the Journal for December, 1937, Vol. 8, No. 4, page 35. Enquiries on this subject are always welcomed but full details should always be supplied with specimens.

Copies of this number issued locally have a leaflet for reference in dealing with garden pests which appeared in the Journal in 1929 (Vol. 2, No. 2).

ENTOMOLOGICAL NOTES.

By

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Entomologist.

1. THE AVOCADO BEETLE BORER AND MEALY BUG.

In last year's Journal (1), the writer dwelt at some length with the small shot-hole beetle *Xyleborus morstatti* Hag. which was there reported for the first time from Viti Levu on avocado pear. Since then investigations have shown that a complete gallery may contain up to 26 insects in various stages —legless larvæ, pupæ and adults—and the damage may be extensive enough to kill the tree outright. And larger species has since been taken.

Other species of this genus attack branches of avocado pears in Hawaii (2) and Ceylon and will quickly kill a tree if affected branches are not cut off and burned or the insects dug out from the trunk. All wounds should be covered over with carbolineum or any proprietary pruning paint.

Painting with coal tar creosote is also effective as it kills the ambrosia fungus on the walls of the gallery which is the food of the grubs.

The mealy bug *Icerya seychellarum* Westw. is pinkish red, covered with a white or yellow wax and can be controlled by a standard kerosene emulsion applied as a spray on the leaves.

(1) *Agricultural Journal*, Fiji. 1938, Vol. 9, No. 1, March.
(2) Higgins, J. E., Hunn, C. J. and Holt, V.S. 1911. Hawaiian Agric. Expt. Stat. Bull. No. 25.

2. TERMITES OR " WHITE ANTS."

So far as we know only six species of termites occur in Fiji, none of them being earth-dwellers and only one exclusively confined to the jungle. This species, *Eutermes olidus* Hill, is doubly recognizable, first by its carton nests built on tree trunks and under bark and secondly by the pointed bird-like snout of the soldier caste (Fig. 1). The average length is 3·5 to 4·5 mm. and as it has never been found away from jungle conditions, it may be dismissed from further notice. As the soldiers are the easiest caste to recognise they are selected for description throughout this article and in the plate.

Three species are commonly found in timber the most serious being *Coptotermes* (?) *acinaciformis* Frogg., whose soldiers are recognized by the oval, orange head with a cup-like pore and the plain and slender jaws (Fig. 2). It measures 6 to 6·5 mm. in length and has been found making a nest within logs of the grey iron-bark (*Eucalyptus paniculata*) specially imported from 1914 onward from Australia on account of its supposed resistance to these insects. This wood was used for the staging of the main wharf in Suva and a questionable record shews this termite may have attacked the timber of a house in 1932 but all recent records are from this Eucalyptus only in which it may have reached the Colony.

The largest species is *Kalotermes repandus* Hill. whose soldiers measure 9 to 13·5 mm. in length. The head alone is larger than a soldier of *Eutermes* and is nearly rectangular with no dorsal pore, the jaws are stouter, shorter and powerfully toothed (Fig. 3). This is the most usual pest in houses and extensive but insidious damage was seen by the writer in June, 1938, in Suva. It occurs also in old *Anona* trees in Samoa but not, apparently, as a pest (1) which is unexpected in comparison with Fiji. The winged forms are frequently attracted to artificial light.

The last important species is *Cryptotermes* (*Kalotermes*) *buxtoni* Hill, which is the scarcest: the soldier is easily distinguished by the dark downwardly directed head with short jaws and the short 13-jointed antennæ (Fig. 4). The length over-all is 4 mm. Only one local record is available of this species in buildings, viz., the staff quarters of a building in Suva in 1932. This appears to be the only harmful termite in Samoa (1) where it occurs in furniture.

For purposes of record the two remaining species of Fijian white ants are here given, viz., *Kalotermes taveuniensis* Hill, (taken on Taveuni Island in 1924) and *Prorhinotermes inopinatus* Silv. described in 1909: a colony was found by the writer in 1938 in the door of a launch but only workers were taken before the door was destroyed, any soldiers being burnt soon after its presence was reported.

It is interesting to note that Simmonds (3) refers to 1932 as being " the first time that the attention of the Department had been drawn to severe damage to city buildings " though twenty-one years earlier Jepson (4) had remarked that " damage by white ants is unfortunately very extensive to furniture, wooden fittings and walls of bungalows."

What the present writer would like to stress is the desirability of sending to, or retaining for examination by, the Entomologist specimens of any white ants before completely destroying the whole colony so that records are lost of the species concerned. This has happened often in the past and critical records are badly wanted as authoritative data are inadequate.

The prevention of damage to houses is more a matter for the architect and the contractor than for the pure entomologist. Routine precautions involving the use of concrete piles with zinc shields or caps so as to isolate all woodwork from contact with the ground are well known to all who live

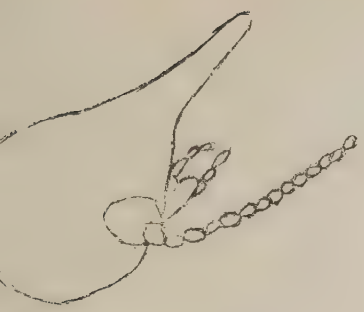


Fig.1. X 35.

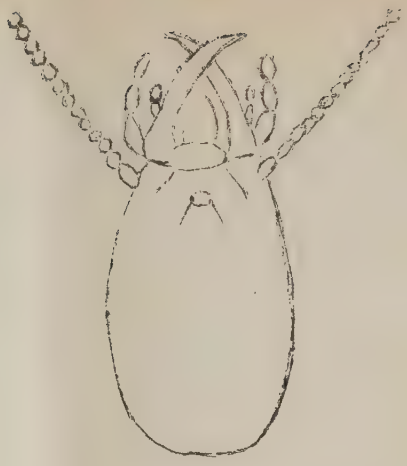


Fig. 2. X 40.

Fig.3. X 25.

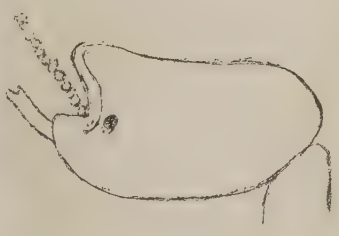


Fig.4. X 30.

R.M. 1/39.

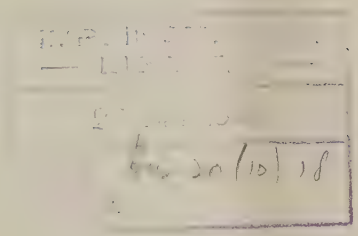
Fig.1. Eutermes olidus Hill. Lateral view.

Fig.2. Coptotermes acinaciformis Frogg. Dorsal vi

Fig.3. Kalotermes repandus Hill. Dorsal view.

Fig.4. Cryptotermes buxtoni Hill. Lateral view.

HEADS OF SOLDIERS OF FIJIAN TERMITES (WHITE ANTS).



in tropical bungalows. The use of seasoned timber, especially heart wood; employment of resistant wood; employing smooth surfaces; the filling-in cracks and application of paint or of coal tar creosote all make a great difference to the amount of damage done and attention to drainage of the soil should not be overlooked as most white ants are encouraged by dampness under buildings. *Prorhinotermes* is often a damp wood species so it should not be given a chance to enter by this means.

The deadly Paris green is effective if blown as a powder into the galleries of termites already present but one can never be sure how far back their ravages extend in house walls. Preference has been shewn in the last few years for sodium silicofluoride or fluosilicate applied similarly in the finest ground form: the simpler product sodium fluoride is also recommended and can be procured locally.

One of the best publications of its kind for termite control in the tropics is a Colonial Office memorandum (5) whose conciseness alone makes it deserving of more attention that it usually receives. A method said to be infallible both in West Africa and the West Indies for eradication of termites already in buildings is into make a paste with water, equal parts of white arsenic and calomel. Within five or six days the whole nest has been poisoned by the dead insects being eaten and the poison carried through the Colony which must not, however, be disturbed in any way.

A correction may be mentioned of a reference in Erhorn's article in a recent work (6) where *Neotermes connexus* Snyder is said to occur in "Fiji (Moorea)," this being clearly a slip as the insect is absent from this Colony and Moorea is an island near Tahiti.

The writer desires to thank Mr. G. F. Hill, Senior Research Officer, Division of Entomology, Canberra, for his assistance in identifications of South Sea Islands termites over a number of years.

(1) Hill, G. F., 1927. "Insects of Samoa." Part VII, Fasc. 1.
(2) Hill, G. F., 1926. *Proc. Roy. Soc. Victoria*, Vol. XXXIX, November.
(3) Simmonds, H. W., 1932. *Agricultural Journal*, Fiji, Vol. 5, No. 1.
(4) Jepson, F. P., 1911. *Council Paper*, No. 25, Fiji.
(5) Colonial Office Enclosure, 1932. With Circular Despatch of 21st December.
(6) "Termites and Termite Control," 1934. Ehrhorn, E.M., in Chap. 27, p. 323.

3. PLEUROTROPIS PARASITE IN TONGA AND WESTERN SAMOA.

In an article in the last issue of the *Journal* (page 13) reference was made to the minute Javan parasite *Pleurotropis parvulus* Ferr. which had been collected in Lau and sent from Suva to Tonga. This voyage from Tonga to Suva takes only six days but the return journey—as used for the insects—normally takes three weeks, but in December and January was no less than twenty-six days.

As it was not possible to send parasitised pupae of the leaf-beetle *Promecotheca reichei* Baly., the adult parasites had to be sent instead.

Previous experience showed that they could not endure refrigeration for nearly a month and small drops of honey required as food dried up during this period. If the drops were made larger, they acted as traps for the parasites as it will be appreciated that to an insect about one-twenty-fourth of an inch in length, a drop of honey only a quarter of an inch in diameter is roughly equivalent to a saucer of milk four yards across for a cat two feet long. Accordingly, a new technique was devised in which raisins were sewn on strips of cardboard, thereby providing a sweet food which kept moist over a fairly long period, though mould or mildew had attacked the

fruit before Tonga was reached. It was therefore gratifying to learn subsequently that all but one tube arrived alive though a further small batch sent by a so-called " direct " boat to Tonga failed to live: they had however been kept for several weeks in Suva before this opportunity presented itself. Unfortunately a hurricane was experienced in the Tonga-Samoa region shortly after the liberation of these wasps and this must have caused some mortality.

The shipment to Western Samoa reached Apia " alive and very active " and " about half were liberated in two different plantations where the leaf-miner was in evidence." The hurricane and accompanying rain were even more severe in Samoa than in Tonga and further details of the establishment of this Javan wasp will be awaited with interest.

In this connexion the article on the " Effect of Cold Storage " on such parasites is of interest as the mere arrival alive of a batch of insects may not be enough to get it established if the power to reproduce has been lost by chilling on the voyage.

4. ADDITIONAL NOTES ON DIET OF THE GIANT TOAD.

Millipedes, centipedes, slugs, snails, weevils, other beetles and ants have all been recorded from the stomach of the introduced toad, *Bufo marinus* (L.). Of two females dissected in February, one had remains of a scorpion, several spiders, ants and the plant-bug *Geotomus pygmæus* Dall and the other had 17 ants, 20 *Subulina* snail shells, one Tenebrionid beetle, one weevil and one cockroach besides pebbles and plant matter. Many householders in Suva have had ocular proof that the toad may eat quite considerable numbers each evening of the large *Periplaneta* cockroaches.

During a visit to some rice fields in the Wainibokasi area of the Rewa delta, the writer found that a cutworm, believed to be *Cirphis unipuncta* Haw. was being taken by the toads, a male having no less than 18 caterpillars in its stomach and a full intestine. As the toads are very numerous in this part of Viti Levu, the toll by this means must be quite heavy. In this Journal for September, 1938, (page 21) it was suggested, after a visit to the northern part of Viti Levu in June, 1938, that some control might be expected from the giant toad and this is now seen to be borne out by experience.

5. A TIGER BEETLE FOR RHINOCEROS BEETLE CONTROL IN SAMOA.

Early in February a shipment of the tiger beetle *Catascopus facialis* Wied. was sent from Malaya by air mail to Australia for transhipping *via* Auckland where it was fed and cared for by the Dominion entomologists. On arrival at Suva en route to Western Samoa, the two boxes of beetles were examined by the Entomologist, the sphagnum moss dampened, ants killed and tanglefoot applied to prevent subsequent invasion by ants.

These voracious tiger beetles measure 12 to 14 mm. (over ½ inch) in length and were forwarded by Mr. H. W. Simmonds, O.B.E., from the Malay States for use against the young stages of the rhinoceros beetle, *Oryctes rhinoceros* L., which is a severe coconut pest in Samoa. These tiger beetles are a beautiful metallic greenish blue, the wing-sheaths being striated but the head and thorax smooth. In the Suva laboratory two individuals in petri dishes eviscerated cut-worms, killed house-flies and even attacked the evil-smelling *Leptocorisa* bug. The local tiger beetle, *Cicindela vitiensis* Blch., is a much more delicately made insect and has iridescent designs on its elytra, which are smooth.

NOTES ON WEEDS IN FIJI.—II.

Lythrum hyssopifolium Linn.

By
B. E. V. PARHAM, M.A.,
Agricultural Officer, South.

This weed has been sent in for identification and has been recorded from a number of localities in Viti Levu. It occurs commonly along roadsides and in low lying flat-land in the wetter parts of the island and has spread rapidly in pasture lands.

The plant may be easily recognised by the glandular (sticky) hairs with which the stems are covered and by the numerous small pink flowers and the persistent calyx which splits unevenly when the seed is shed and remains as a flat shield-like body. Frequently small moths, flies and other insects may be found entangled in the sticky exudate from the glandular hairs on the stems.

The following is a brief botanical description of the plant which shows considerable variation in height and in size and shape of the leaves.

Rootstock woody; stems 2 to 3 feet high, branching, clothed with glandular hairs. Leaves opposite often alternate, sessile, lanceolate, 1–2½″ long. Flowers small solitary, reddish-purple or pink, nearly sessile in the axils. Calyx tubular, 8-ribbed, about ½″ long with six lobes or teeth, petals, six; stamens 6 or 12 inserted below the middle of the calyx. Ovary 2-celled with several ovules in each cell, style filiform with capitate stigma. Capsule oblong, bursting irregularly, the branched axial placenta persistent. Plants usually found in wet land.

The plant is well adapted to its habitat and as the production of seed is very high its spread is rapid. Cattle do not touch it.

The family is Lythraceæ, of which the loose strife is a common member related to the weed described above.

I am indebted to Dr. Carl Skottsberg, of Gottenburg, Sweden, who passed through Suva recently, for confirmation of the identification of this plant. There is no previous record of its occurrence in Fiji.

THE SAGO PALM—A VALUABLE SOURCE OF FOOD.

By
B. E. V. PARHAM, M.A.,
Agricultural Officer, South.

The Sago palm (*Metroxylon vitiensis*) known to the Fijians as "soga" is one of the commonest indigenous palms of the Group. It occurs in extensive groves in swamps throughout Viti Levu and is best known to natives as the source of valuable thatching material and to Europeans as an ornamental palm for indoor cultivation (in the young stage) and as the source of the so-called ivory-nut (the fruit).

The palm grows to a large size—when full grown being 30 to 40 feet high with a trunk 4 to 6 feet in girth, and flourishes best on marshy soils. The large pinnate fronds are 20 feet long and the petioles and midribs densely clothed with long fine, needle-like thorns. The palm is best propagated from seeds sown in a well-prepared nursery but it may also be grown from suckers if care is exercised in severing the suckers from the parent palm.

The seeds should be planted about one foot apart in slightly raised nurseries and are usually ready for planting out in 15 to 18 months. The seeds, in the husk, are first covered with soil and the nursery beds should be shaded until three leaflets are showing in the seedlings. Palms should be planted closely,

say, 18 or 20 feet apart in fair average conditions, though in the wild state they usually grow in clumps of several trees quite close together. At maturity, just before flowering the plams are cut down for sago production and at each stool one sucker is permitted to grow to replace the felled palm.

The leaflets are stripped from the leaves and sewn on to reeds for thatching houses in south-eastern Viti Levu. This material is particularly valued by Solomon Islanders resident in Fiji and it appears that the Fijians have adopted its use in comparatively recent times. When smoked it forms one of the most durable of roofing materials—being said to last up to twenty years or longer.

Although the Sago palm has for centuries provided the main article of food for large numbers of natives in the East, the Fijians appear to have been ignorant of the fact that the trunk of the indigenous species contains starch and they have not yet learned how to extract this. The smooth-stemmed variety is said to be more prolific than the spiny-stemmed type.

The importance of the Sago palm in the East Indies may be indicated by reference to recent production figures in Borneo (3). During 1937 in North Borneo there was an increase of 2,086,866 pounds in production or 39·18 per cent. and an increase in exports of 731,315 pounds or 17·09 per cent. in comparison with 1936. The reason for the increase in the quantity exported was stated to be due to better market prices offered for sago flour.

The average price quoted in Singapore for pearly sago (small fair) during the year was $5·24 and sago flour (fair) $3·41 per picul (133 lb) in comparison with $4·10 and $2·63 respectively during 1936. ($ = 2s. 4d. sterling).

Throughout 1937, sago flour was sold at a profit which resulted in sago-refining factories working full time. The total production for the year was 9,544,600 lb and the estimated area of sago palms was 13,941 acres.

In New Guinea, sago represents about 80 per cent. of the food requirements of 700,000 native people. Dekking (4) states that four " boys " will wash 600 lb of starch in one day and that the local price for plantation labour ration is £12 per ton as compared with £22 per ton for rice. (2½ lb rice is equivalent to 2 lb of sago). The cost of labour is about £5 10s. 0d. per ton, including royalties.

During 1938, a quantity of sago flour was produced experimentally at the Central Agricultural Station. The method employed was of the simplest and the work proved easy and inexpensive. The mature palms were cut and the stems cut into lengths of 3 to 4 feet—which were split and the whole of the pith removed and grated by hand into a vessel containing water. The starch washed out of the material settles almost immediately and three or four washings and then sieving through gauze netting were sufficient to produce a starch of a pale pink colour (almost white). With the simplest of tools, two men could handle one palm in five days and the estimated production per palm is 600 lb of starch yielding about 200 lb of marketable sago (2). After washing and settling the starch is cut out in blocks and dried in the sun or over charcoal fires.

The quantity of starch obtained depends upon the age and maturity of the tree. The maximum starch content of the trunk occurs just before the palm flowers which it does only once in a life time at the age of 10 to 20 years. After fruiting the palm normally dies so that the utilization of a tree for starch production does not involve the destruction of potentially valuable material.

Attention is drawn to this source of food as there appears no reason at all why it should not be utilized in times of need locally as it is elsewhere. It is stated by Wallace (1) that in Ceram, a good-sized tree produces 600 lb of

sago flour which made into cakes is sufficient food for one man for one year. The cakes may be stored and keep well after drying in the sun.

The sago of commerce is obtained by mixing the sago flour or meal with water to form a paste which is pressed through cloth and then through sieves with fine meshes and falls into a shallow pan heated over a fire and is thus granulated to form "pearl" sago. This product is practically pure starch, which according to Dekking (4), has the following composition:—Water 13·5 to 15 per cent.; protein nil to 0·4 per cent.; ash, 0·1 to 0·4 per cent.; minerals, 0·1 to 0·2 per cent. and starch 84 to 88 per cent.

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AN EDIBLE FUNGUS

(*Hirneola polytricha* Mont.)

By
B. E. PARHAM, M.A.,
Agricultural Officer, South.

Attention has recently been drawn by the Director of Agriculture to one of the larger saprophytic fungi which from time to time figures in the export list of several countries, in some of which it is classed as a minor forest product.

This fungus is *Hirneola polytricha* Mont. (= *rufa* Berk), a southern hemisphere species distinct from the European *H. auricula judæ* Berk, but generally known by the same common name as the latter, viz., "Judas' Ear" or "Jew's Ear" (4).

The dark brownish gelatinous masses formed by the plant on decaying wood are common objects no doubt familiar to most people.

As in China, this fungus is esteemed as a delicacy and is indispensable at feasts, it has, in the past, had a decided economic importance in New Zealand and the South Sea Islands, particularly Tonga, from which countries it has been exported in a dry state.

According to Rolfe (3), the New Zealand trade began in 1871 and increased rapidly. Available figures of exports, mainly to Hong Kong are shewn in the following table:—

Year.	*Quantity exported.*	*Value.*
1918	2,054 cwt.	£5,784
1921	1,616	12,852
1931	1,840	9,990
1932	1,330	5,900
1933	1,028	3,270

The price recorded varied from 3d. to 16d. per pound (5).

The fungus is common in Fiji, growing sporadically on dead wood, fence posts and stumps or branches in the forest. It has been specifically recorded from Nadarivatu (1) and is known to occur in Nadroga and all the wet districts of Viti Levu where it is called "dalidaliga" (*i.e.*, like an ear) by the Fijians.

Little information is available regarding either any local demand or the quantities available although reports have been received of local purchases by Chinese storekeepers.

The Agricultural Assistant, South (Mr. J. C. Suckling) states that local records show that small quantities were exported from Fiji in 1905—the price being approximately 5d. per pound, the best grades being known as "Chuan Erh" and "Shih Erh."

The Agricultural Officer, West (Mr. D. A. Donald) reports that there are two varieties known in Nadroga the light-coloured is called "taliga," *i.e.*, "ear" and the dark-coloured, "kwere kwere."

Rolfe (2) states that the common Chinese name is "Mu erh," and that in Shin-si Province it is grown extensively in copses of small oaks (*Quercus variabilis*) and shipped to Hankow for distribution. In China it grows naturally on decaying oak stumps or is cultivated artificially, requiring a damp atmosphere with sufficient heat for its proper development.

The method of cultivation is interesting. Small sapling oaks about six inches in diameter are cut down and the branches removed, leaving the bark entire. These poles are cut into eight or ten foot lengths, which when left on the ground for several months become infected by the mycelium of the fungus. They are then stacked in piles and the following year the familiar brown fungus, which is really the functification or fruiting body, appears and is removed from time to time and dried.

In Japan, the plant is known as "Kikurage" and grows on mulberry and elm. It is recorded in "Forestry in Japan" (2) as "very nice food." Correspondence from local readers interested in this product is invited.

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NUTRITIONAL DEFICIENCY IN LOCAL STOCK.

By
H. T. B. HALL,
Acting Senior Veterinary Officer.

While on a recent visit to Lautoka and Ba a number of stock were observed to be suffering from some deficiency in their diet. Besides the well known low plane of nutrition due to protein deficiency, it seems very apparent that some material is required to balance the diet in these districts. From symptoms observed, it would seem that there is a decided upset of the calcium-phosphorus balance and that a mineral supplement consisting of bone meal and salt in the proportion of one part of bone meal to two parts of salt would be useful pending further investigation work to find out the exact nature and extent of these deficiencies. It is recommended therefore, that wherever stock are not hand-fed and have only pasture, the above lick should be placed out in boxes which are protected from rainfall either by making a shelter for the box or placing it is a shelter shed. The box should also be raised on legs to prevent moisture being absorbed from the ground.

REVIEWS.

TREATMENT OF HIDES.

A good deal of damage is caused to hides stored and preserved under the hot wet conditions prevailing in Fiji by the skin Beetle *Dermestes* sp. also known as the hide beetle or leather beetle. It is closely allied to the common larder beetle of food stores and like the latter is of world-wide distribution. It can live on meat and other materials rich in protein, but is most noteworthy for the extensive damage it causes to stored hides and skins, and

to the baled goods in transit. It is of the greatest importance, therefore, that measures be taken to prevent or minimize such damage in the period elapsing between the completion of the curing and the time when the goods reach the consumer. Storage at ports in warm countries and in the holds of ships presents conditions highly conducive to the rapid multiplication of the beetles, and thus to the development of irreparable damage.

The insects feed on both sides of the hides and skins, but the damage on the hair side is the more important as it destroys the grain, which is often eaten off, leaving large white patches destitute of hair. On the flesh side patches of adhering fat are particularly attractive to the pest, and removal of excessive fat is therefore, an aid to preservation.

The usual method of treatment of hides in this country is by salting and the following are the principle points to which attention should be directed.

With regard to salting it should be remembered that it does not necessarily follow that once a hide has been salted it can be left without further attention for an indefinite period. When hides are stored, therefore, they should be kept under observation, and re-salted periodically to keep them in good condition. Speaking generally, it is better to be over-thorough in this respect than to leave them without sufficient salt, as in the latter case serious damage is likely to be caused. It should be noted in this connection however, that when wet-salted hides are sold on cured weight, they must be freed from excess salt before weighing. The International Council of Tanners has laid it down that wet-salted hides and skins should stay under salt in piles flat and without folding round the edges, for at least 21 days. Before bundling and weighing they should be banked on a lattice for 48 hours, and then biffed against the lattice once on the hair side and once on the flesh side to remove excessive salt and moisture. They should then be weighed, and afterwards should be protected with a light sprinkling of dry salt to keep them in condition during transit. In the case of dry-salted hides there is no necessity to re-salt, as the hides will keep in good condition for a very much longer period.

With regard to hides and skins generally, it is important that they should be kept in a place which is cool and well ventilated, and away from the direct light of the sun. In all cases care should be taken to see that they do not come in contact with metal fittings, which are liable to cause stains in the finished leather, or with other materials which may cause damage.

Preparation of Empire Hides and Skins, J. R. Furlong (Editor), Imperial Institute, London, 1937.

—H.T.B.H.

MYCORRHIZA.

In a recent paper * Rayner gives an account of results obtained from ti inoculation of forest nurseries, based on replies received to a questionnaire sent out from the Imperial Forestry Institute, Oxford, to Forestry Departments and Research Institute overseas.

While the importance of the symbiotic relationship of certain bacteria with nodule-forming plants has long been recognised, the association of the mecelium and host in mycorrhiza-formers has received less attention and the exact physiological relationship is not fully understood. The habit is, however, widespread among crop plants and the not infrequent difficulties met with by foresters in the establishment of exotic plantations is convincing evidence of the significance of mycotrophy.

* The Use of Soil or Humus Inocula in Nurseries and Plantations. M. C. Rayner. *Empire Forestry Journal*, Vol. 17, No.2, 1938.

The author discusses the replies to the questionnaire which indicate that where exotics have been introduced inoculation for the purpose of mycorrhizal infection is usual and necessary to obtain vigorous growth. An exception is the Union of South Africa where the mycorrhiza-forming fungi are apparently of widespread local occurrence. Many of the replies had reference to species of pines and confirmed previous observations that the same fungus may be associated with a number of species but be unable to form mycorrhizas with others; further, a number of different fungal species may form balanced associations with any one species of tree.

The practical importance of the condition of the inoculation soil or humus in respect to moisture is stressed by the author, together with the need for a technique by which small amounts of potentially active material may be used to " spawn " locally prepared heaps of suitable organic material.

—C.H.

PEANUTS.

The Queensland Producer of October 5th, 1938, shows that Australia imported in 1936–37 over 2½ million pounds weight of peanuts. Of this quantity 262,000 lb were imported for consumption as nuts on which there is a duty of 6d. per lb for shelled and 4d. per lb for unshelled nuts, except that imports from New Guinea and Papua are free of duty. Peanuts for oil extraction purposes may be imported free of duty on application to the Minister for Customs and for this purpose 2,408,126 lb were imported in 1936–37. The oil extracted is utilised mainly in the manufacture of margarine.

Peanuts are also produced in Queensland in increasing quantities.

—H.W.J.

FOOD VALUE OF SOYA BEANS.

In the United States of America and South Africa soya beans have been found to increase the milk yield if fed to dairy stock and to give excellent results in the fattening of cattle. Soya beans contain about 17 per cent. of oil and 40 per cent. of protein as well as about 20 per cent. of carbohydrate and 4 per cent. of fibre and thus provided a most valuable food for all stock.

The beans are best fed as a meal mixed with maize meal in the proportion of 1 to 5; the growing crop also provides an excellent fattening fodder and is suitable for preservation as silage or for stall feed as " chop-chop."

The beans grow well in Fiji under fair average cultivation conditions and can be supplied in very limited quantities at certain seasons of the year at prices similar to cotton seed and are well worth a trial by dairy farmers.

—H.W.J.

NUTRITION AND LAND SETTLEMENT.

The Conference* considered that the nutritional problem in the Colonial Empire is basically economic and agricultural and can be tackled successfully by the closest co-operation between Medical, Agricultural, Veterinary and Education Departments.

There would appear to be definite indications that carbohydrate intake is too high and that emphasis should be given to the greater consumption of proteins, particularly in the form of meat and animal products. The diet should also include greater amounts of fruit and green leafy vegetables.

*Report and Proceedings of Conference of Colonial Directors of Agriculure, 1938, Col. No. 186. 2s.

In considering methods for increasing meat consumption, the Conference discussed mixed farming and poultry keeping.

From the vitamin stand-point, the Conference considered that Departments of Agriculture should give greater attention to the development of vegetable gardens and that endeavours should be made to encourage the use of under-milled or parboiled rice in place of polished rice.

The conference of Colonial Directors of Agriculture held in July, 1938, recognised the importance of properly organised land settlement as a means of allevating certain pressing social problems throughout the Colonial Empire.

—W.J.B.

The following factors essential to success were stressed as requiring careful consideration:—(1) suitability and accessibility of land selected for settlement, (2) water supply, (3) types and subsequent training of settlers, (4) systems of tenure and (5) a long view in planning.

Careful attention should be given to systems and methods of cultivation and the controlling authority should have power to enforce proved methods for the conservation of soil fertility.

For economic working, small-holders should be banded into co-operative groups for purposes of the provision and purchase of implements, tools, &c., and for the harvesting, preparation and marketing of produce.

It was pointed out successful land settlement is costly, and that a proportion of non-recoverable expenditure must be faced if ultimate success is to be achieved.

In planning schemes, adequate thought must be given to the questions of suitable crops, available markets and the production of food as well as of cash crops which will assure a reasonable standard of living.

Great value is attached to full preliminary investigarion not only of the economics of local peasant agriculture but also of the factors referred to above, in order to avoid the major folly of establishing untrained settlers on unable suitsoil.

—B.E.V.P.

COLONIAL MARKETS.

It may presumably be taken as a sign that the importance of Colonial trade is at last beginning to be appreciated in this country when the Times devotes, as it did recently, its first leading article, and a lengthy one at that, to the subject. The occasion was provided by a letter from Sir Harry Lindsay, drawing attention to the functions of the Colonial Empire Marketing Board, and indicating some of the work which it hopes to undertake. Sir Harry began by wondering if it is realised that the total aggregate trade of the Colonial Empire is nearly half that of the Dominions and India, and about a third of that of the United Kingdom, and he might have added that the Colonial Empire taken as a whole is already the largest oversea customer of this country, and has the potentiality of becoming a very much larger customer still. It is unfortunately true that these and other facts about Colonial trade are by no means yet sufficiently realised in this country, as this journal, which has been preaching the importance of Colonial trade for the past seven years, has only too good reason to know.

In commenting on the letter, the leading article in question ranges over many Colonial topics, the West Indies, West Africa, the Colonial Service and administration, agriculture, and Colonial policy generally, but in referring to the development of exports from the Colonies, it points out the obvious truth that this, in its turn, will create new outlets for the manufactured goods of Great Britain. These are indeed the obverse and reverse of the medal, but it does not follow that, because the development of production

in the Colonies and the successful marketing of the products in this and other countries increases Colonial purchasing power, the British manufacturer will necessarily benefit proportionately from this prosperity unless he is fully alive to the openings thus created, and is afforded every facility and encouragement to sell his goods in Colonial markets.

The task of the Marketing Board ought, therefore, to be a double one. All trade is a reciprocal process, but there is some danger that in concentrating too exclusively upon increasing the output and consumption of Colonial products, the equal duty of assisting British trade with the Colonies may be comparatively neglected. It is obvious that if United Kingdom export trade with the Colonial Empire can be developed up to the limit of its great potentialities, this country will be in a better position to assist Colonial development and more British capital will be attracted to the exploitation of the Colonies' natural resources, thus setting up a beneficial cycle to the advantage of both parties. Whilst, therefore, the Board's activities as described by Sir Harry Lindsay, in encouraging increased consumption of Colonial products, fulfil a valuable and much-needed function, it is to be hoped that the Board, and those responsible for it, will take the larger conception of its task and do everything possible to impress upon British manufacturers and merchants the potentialities and the needs of Colonial markets for their goods and assist them in every possible way to develop their trade with those markets. It has been said that this is primarily the duty of the Department of Overseas Trade, but that the Department necessarily includes all overseas trade in its scope, and so far as the Colonial Empire is concerned, the Colonial Marketing Board, in conjunction with the Department, can do a great deal of useful propaganda work in the double and mutually helpful task of increasing Colonial trade with this country and British trade with the Colonies.

—From *The Crown Colonist*, October, 1938.

EXTRACT.

THE EFFECT OF COLD STORAGE ON THE REPRODUCTION OF PARASITIC HYMENOPTERA.

"The low temperatures generally used in biological control work are above the threshold of metabolism (1) of the parasite. The optimum storage temperatures are considered to be just below those which would permit development to continue to the following stage. Such temperatures, however, may insure the survival of the individual but not the survival of the species.

"It is customary to place parasites in cold storage when they are mature larvæ or pupæ, for experience has shown that *emergence* of the adult is then least affected. Metabolic activity during the mature larval and pupal periods is dependent on nutritive material accumulated in the body during the immature larval stages. If storage is prolonged it is evident that the parasite may not have sufficient material with which to complete its development. The organs most likely to be affected by insufficient nutrition are those used in reproduction. The germ-cells which undergo their greatest development during the pupal and adult stages appear to be adversely affected. The spermatozoa in particular seem to lack vitality.

"In dissecting several adults of a species of *Tetrastichus*, some of which had been stored for two weeks as pupæ, the writer observed that in the unrefrigerated specimens the fat-cells were abundant, whereas in the refrigerated ones they were scarce.

" Hanna observed that the adults of a wasp *Euchalcidia* produced progeny in the normal sex ratio when exposed as larvæ to low temperatures, but if exposed as pupæ they produced progeny consisting mostly, if not entirely, of males. Since *Euchalcidia* is arrhenotokous (2) this indicated that the male pupæ were more or less sterilized, at least temporarily. Hanna found that oogenesis (3) was much less affected than spermato-genesis (4). This indicates a correlation with nutrition. Uvarov states that the development of gonads may be seriously inhibited by temperature which can hardly be called low in the usual sense of the word. The experiments of Hanna constitute a remarkable example of such a phenomenon. He subjected male pupæ to a constant temperature of about 60·8 degrees F. (16 degrees C.) for periods of 10, 25 and 40 days and found that the 10-day exposure resulted in 70 per cent. sterile males, the 25-day exposure 90 per cent. sterile males and the 40-day exposure 100 per cent. sterile males. It should be noted that 60·8 degrees F. can be called low only with respect to this *Euchalcidia*, a tropical species. The breeding of parasites at temperatures not considered low may result in the progressive decline of the proportion of females in successive generations until the stock dies out completely.

" The optimum temperature for the production of sperm in the parasitic Hymenoptera may be in the neighborhood of 86 degrees F. (30 degrees C.) as Anderson found to be the case of *Habrobracon*.

"Anderson and Van Steenburgh have shown that the fertility of parasites subjected to low temperatures during the development may be adversely affected. Supposedly healthy mature parasites, therefore, may be in fact more or less impotent. The recognition of this possibility is of considerable importance in biological control work.

"A statement of Schread and Garman to the effect that the progeny of refrigerated (38 degrees to 40 degrees F.) specimens of *Trichogramma* consisted mostly, if not entirely, of males first suggested to the writer the reason for the failure of many introduced parasites to reproduce, *i.e.*, sterility of the male as a result of cold storage during shipment . . . . .

" Possibly hymenopterous (5) parasites should be held in storage as either immature or as adults if their reproductive capacity is to be unimpaired. The exposure to low temperature during these stages probably would not be detrimental if interrupted at regular intervals for short periods of normal respiration and feeding."—S. E. FLANDERS in *Journal of Economic Entomology*, Vol. 31, No. 5, October, 1938.

(1) The process of conversion of food into body tissue and waste products.
(2) Production of males only.
(3) Formation of eggs or ovarian tissue.
(4) Formation of sperms.
(5) Membrane-winged insects such as wasps and bees: they are the l parasites of other insects.

Dates and specific names omitted.—EDITOR, A.J.

RAINFALL AND MEAN TEMPERATURE AT SUVA, 1938.

	Inches of rain.	*Mean temperature.*
January	12·53	81·2°F.
February	8·45	81·8
March	8·54	80·2
April	4·96	79·5
May	11·58	77·7
June	4·84	75·9
July	14·32	78·5

August	7·05	76·1
September	15·68	76·0
October	19·61	77·0
November	20·77	78·6
December	30·52	78·7
Total ..	158·85 inches	

The average rainfall for 53 years is 119·46 inches so that 1938 will go down as one of the wettest years recorded. March and April with 8·54 and 4·96 inches respectively, in place of the average of 14·32 and 12·38, were exceptionally dry months; the last four months were much wetter than the normal, September, October, November and December having 7·57, 8·86, 10·14 and 12·50 inches respectively as average monthly figures which were thus doubled or more than doubled last year.

Data recorded by Harbour Master, Suva. —R.J.A.W.L.

DEPARTMENTAL NOTES..

RETURN FROM LEAVE.

THE Government Chemist, Mr. W. J. Blackie, has returned from leave and a Commonwealth Fellowship spent in the United States and England. He is to be congratulated on becoming a Fellow of the Institute of Chemistry.

NEW ARRIVALS.

Mr. C. Harvey—Acting Senior Agricultural Officer, Tanganyika, from 1932–34—has arrived as Senior Agricultural Officer.

Mr. H. T. B. Hall and Mr. R. N. Saunders have joined the Department as Veterinary Officers. At present Mr. Hall is acting as Senior Veterinary Officer during Mr. Turbet's leave in the United Kingdom.

DEPARTUE ON LEAVE.

Mr. H. R. Surridge, Agricultural Officer, South, left the Colony on furlough last December for the United Kingdom, Mr. Turbet having preceded him.

RETIREMENT.

Mr. B. L. Field, who joined the Department in 1923, has retired from the Service. He specialized on cotton, a crop with which he became familiar in India, and his knowledge of types and qualities of cotton, of ginning, of grading, packing, &c., was invaluable towards interesting small agriculturists in Fiji in cotton.

The industry flourished for some years until the depression of prices in 1928–29 rendered it unremunerative. Mr. Field greatly assisted towards reviving this industry during the last three years, but fickle weather constantly retarded progress as well as the general prosperous conditions of the small holder. Mr. Field also applied himself vigorously to the rice milling industry, having operated the Government Rice Mill profitably for some years, until its operations ceased in order to give small millers the chance of carrying on the trade. His cheeriness, enthusiasm for his work and efficiency will always be borne in mind and the Staff of the Department wish him and his charming wife a long and happy retirement.

GENERAL.

Mr. A. C. Barnes, C.M.G., Director of Agriculture from 1929 to 1933, before transfer to Jamaica, has retired from the Civil Service to take up the post of Manager of the West Indies Sugar Co. Ltd. in that Colony.

Dr. J. B. Tothill, C.M.G., Director of the *Levuana* Campaign and Director of Agriculture from 1924 till 1929, when he was transferred to Uganda, has now become Director of Agriculture in the Sudan.